

METHOD AND APPARATUS FOR ANNEALING COPPER FILMS

CROSS-REFERENCE TO RELATED APPLICATIONS

12/12/06
[0001] This application is a divisional of ~~co-pending~~ ^{now abandoned} U.S. patent application Serial No. 09/513,734, filed February 18, 2000, which is a continuation-in-part of commonly-assigned U.S. patent application, entitled "Method and Apparatus for Heating and Cooling Substrates", Serial No. 09/396,007, filed on September 15, 1999, now U.S. Patent No. 6,276,072, and of commonly-assigned U.S. patent application, entitled "Apparatus for Electrochemical Deposition of Copper Metallization with the Capability of In-Situ Thermal Annealing", Serial No. 09/263,126, filed on March 5, 1999, now U.S. Patent No. 6,136,163, both of which are herein incorporated by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The invention relates to a method and apparatus for metal processing and, more particularly, to a method and apparatus for depositing and annealing metal films.

Background of the Related Art

[0003] Copper has gained increasing popularity as a metal interconnect in advanced integrated circuit fabrication. Copper can be deposited using electrochemical deposition from electrolytes such as copper sulfate or from electroless processes. Typically, electrolytes also contain carriers and additives to achieve certain desired characteristics in electroplated films. Some copper films, e.g., those deposited from electrolytes containing organic additives, exhibit "self-annealing" or re-crystallization behavior. For example, abnormal grain growth may occur in the as-deposited film such that film properties such as resistivity, stress and hardness may be adversely affected. The rate of grain growth may depend on the electroplating recipe, electrolyte types, as well as the organic additive concentrations.